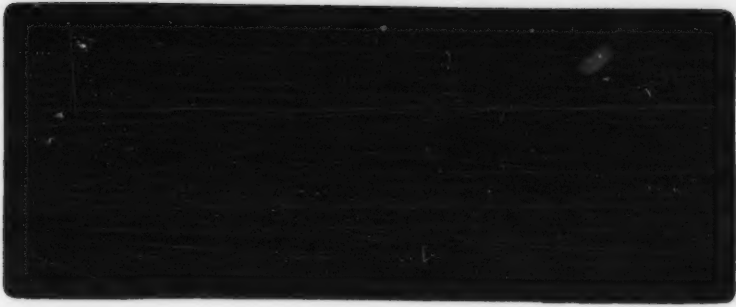


**EARLY STAND DEVELOPMENT AFTER
HARVESTING ON SELECTED SITES IN
NORTHWESTERN ONTARIO**



Ministry of
Natural Resources

**NORTHWESTERN ONTARIO FOREST
TECHNOLOGY DEVELOPMENT UNIT**



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HARVESTING ON SELECTED SITES IN
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by

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May 1991

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PREFACE

This report was prepared by Sheila Walsh and Cindy Krishka during 1989 under the Canada-Ontario Forest Resources Development Agreement. It must be noted that this study was preliminary in nature and somewhat limited in scope. Areas for further investigation are recommended.

Colin Bowling of the Northwestern Ontario Forest Technology Development Unit (NWOFTDU) provided invaluable editorial services on the manuscript.

W.D. Baker
Manager
NWOFTDU

ABSTRACT

Tree species often revegetate harvested forest sites but desirable conifer trees may not be the first to assume dominance. More often, non-crop species are quick to establish high levels of site occupancy, posing a competition problem for subsequent development of conifer trees. This study was designed to provide descriptions of vegetation communities that develop on a range of newly harvested sites across the North Central Region of northwestern Ontario. Relationships between these post-harvest vegetation communities and pre-harvest site classification units were also investigated.

Sampling was conducted on 40 cutovers selected to cover a range of pre-harvest stand conditions. Each sampled cutover was classified to a Northwestern Ontario Forest Ecosystem Classification (NWO FEC) Treatment Unit. All sites had been harvested within five years of sampling, most had been mechanically site prepared but none had been chemically treated.

Patterns in post-harvest vegetation development were very apparent. Distinct combinations of species, abundance levels and height growth were described for each Treatment Unit. Vegetation indices were calculated for each species using abundance and height data and comparisons made among the Treatment Units. Ordination provided a graphic representation of the vegetation data and clearly illustrated the distinctness of the post-harvest vegetation communities among Treatment Units.

A strong relationship exists between pre-harvest classification units defined in the NWO FEC and post-harvest vegetation communities. There is considerable potential, therefore, to develop an accurate means to predict post-harvest vegetation communities from pre-cut stand data. However, the degree of competition imposed by post-harvest vegetation on different sites must be more clearly defined. It is recommended that further investigation be carried out to refine post-harvest site descriptions, to define competition potential on the range of Treatment Units, and to evaluate the effectiveness of various vegetation management options on different sites.

KEYWORDS: vegetation community, cutover, ecosystem classification, ordination, competition.

TABLE OF CONTENTS

	Page
PREFACE	i
ABSTRACT	ii
LIST OF TABLES	iv
LIST OF FIGURES	v
LIST OF APPENDICES	v
Acknowledgements	vi
INTRODUCTION	1
Study Objectives	2
METHODS	2
Study Area	2
Forest Ecosystem Classification	4
Sampling Sites	5
Sampling Procedure	6
Data Analysis	7
RESULTS	9
Species Composition / Frequency of Occurrence	9
Species Abundance and Height Development	12
Vegetation Indices	16
Pre- and Post-Harvest Vegetation Relationships	19
DISCUSSION	21
Potential Implications for Forest Management	23
Recommendations for Further Study	24
SUMMARY AND CONCLUSIONS	25
LITERATURE CITED	27

LIST OF TABLES

	Page
Table 1. Prioritization of sampled treatment units.	5
Table 2. Number and age (years) of cutovers, and number of plots sampled for each Treatment Unit.	7
Table 3a. Percent frequency of occurrence of shrubs by each Treatment Unit (TU) in one to five-year-old cutovers in northwestern Ontario.	10
Table 3b. Percent frequency of occurrence of herbs by Treatment Unit in one to five-year-old cutovers in northwestern Ontario. . . .	11
Table 4a. Mean percent cover of shrubs by height class and Treatment Unit (TU), in one to five-year-old cutovers in northwestern Ontario.	13
Table 4b. Mean percent cover of herbs, grasses and sedges by height classes and Treatment Unit (TU) in one to five-year-old cutovers in northwestern Ontario.	14
Table 5. Summary of species with predominant mean cover values by Treatment Unit, sampled one to five years after clearcutting in northwestern Ontario.	15
Table 6a. Mean Vegetation Index (VI) values by Treatment Unit for shrubs growing in one to five-year-old cutovers in northwestern Ontario.	17
Table 6b. Mean Vegetation Index (VI) values by Treatment Unit for herbs growing in one to five-year-old cutovers in northwestern Ontario.	18

LIST OF FIGURES

	Page
Figure 1. Study area with approximate locations of sample sites (numbers).	3
Figure 2. Ordination of cutover vegetation data. Letters correspond to Treatment Unit classification of the pre-harvest stand condition for each of the forty cutovers.	20

LIST OF APPENDICES

	Page
APPENDIX I Description of NMO FEC Treatment Units Sampled in this Study (from Racey <u>et al.</u> 1989a)	29
APPENDIX II Summary of Soil Conditions Sampled on Forty Cutovers in North Central Region	32



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INTRODUCTION

Revegetation of disturbed forest sites has been investigated in numerous studies (Marks and Bormann 1972; Dyrness 1973; Ellis and Mattice 1974; Halpern 1988; Hamilton and Yearsley 1988). Although tree species often naturally revegetate cutovers, desirable conifer trees may not be the first to develop on a site (Yang and Fry 1981). Ellis and Mattice (1974) reported that herbs colonized cutover sites initially, peaking within two years after harvesting. Herb abundance dropped off gradually as shrub species developed and shaded the site. Most pioneer species are short-lived and are not commonly found in mature stands, but Halpern (1988) found that harvested forest stands ultimately tended to return to their original composition.

Where disturbance has been minimized, species composition varies little from pre-harvest to post-harvest conditions. However, the frequency of occurrence and abundance of individual species may change drastically (Ellis and Mattice 1974; Halpern 1988; Hamilton and Yearsley 1988). This pattern is especially apparent in harvested stands of mixed conifer and hardwood which, if unmanaged, will tend to develop into hardwood-dominated mixedwoods (Ketcheson 1981). Jeglum (1982) reported that a mixedwood stand comprised of 90% conifer and 10% hardwood at time of cutting had changed to 50% conifer / 50% hardwood five years after harvesting. He suggested that if there are any hardwoods in the original stand, there is a potential competition problem for conifers after harvest (Jeglum 1987). Vegetation management on harvested sites becomes a priority when conifers are designated as the primary desirable crop.

Harvesting systems can influence revegetation patterns. For example, hardwood reproduction is favoured when residual hardwood trees are left in the cutover to provide a viable seed source. Disturbance resulting from harvesting may also stimulate germination of seeds long dormant in the forest floor, or

suckering by a variety of tree and shrub species (Jeglum 1982, 1983; Bell 1991). The location of a cutover is also important. If surrounded by mature forest, a nearby seed source for weedy species may be lacking and their development delayed. However, if the cutover is adjacent to an older cut or an old road, a seed source for non-vegetation exists and there will likely be a competition problem (Eis 1981).

Study Objectives

This project was undertaken to provide preliminary observations and descriptions of vegetation communities (species composition and abundance) on a variety of newly harvested sites. It was anticipated that these post-harvest descriptions might provide useful information when anticipating problems of competing vegetation on cutover sites. The specific objectives of this preliminary study were:

1. To describe vegetation communities that develop in the first five years after harvesting on a range of sites in the North Central Region of northwestern Ontario.
2. To investigate the relationship between pre-harvest ecosystem classification units and post-harvest vegetation communities.
3. To speculate on the implications for nursery stock selection, plantation tending and other vegetation management strategies.

METHODS

Study Area

This study was carried out in the North Central Region of Ontario (Figure 1). The Region is characterized by a diverse physical setting and climate (Sims et al. 1989), and both the Great Lakes / St. Lawrence and the Boreal forest regions are represented (Rowe, 1972). Soil/site conditions range from very thin

mineral soils overlying bedrock, to a variety of deep, dry to moist, coarse- to fine-textured mineral soils, and deep, wet, organic soils. Forest canopies are comprised primarily of various combinations of black spruce (*Picea mariana*), jack pine (*Pinus banksiana*), white spruce (*Picea glauca*), balsam fir (*Abies balsamea*), trembling aspen (*Populus tremuloides*) and white birch (*Betula papyrifera*). Species such as white pine (*Pinus strobus*), red pine (*P. resinosa*), and red maple (*Acer rubrum*) occur to a lesser extent, primarily in the Great Lakes / St. Lawrence forest region. Understory conditions are similarly diverse, ranging from shrub- and herb-rich to sparse shrub and herb growth on extensive moss mats (Sims *et al.* 1989).

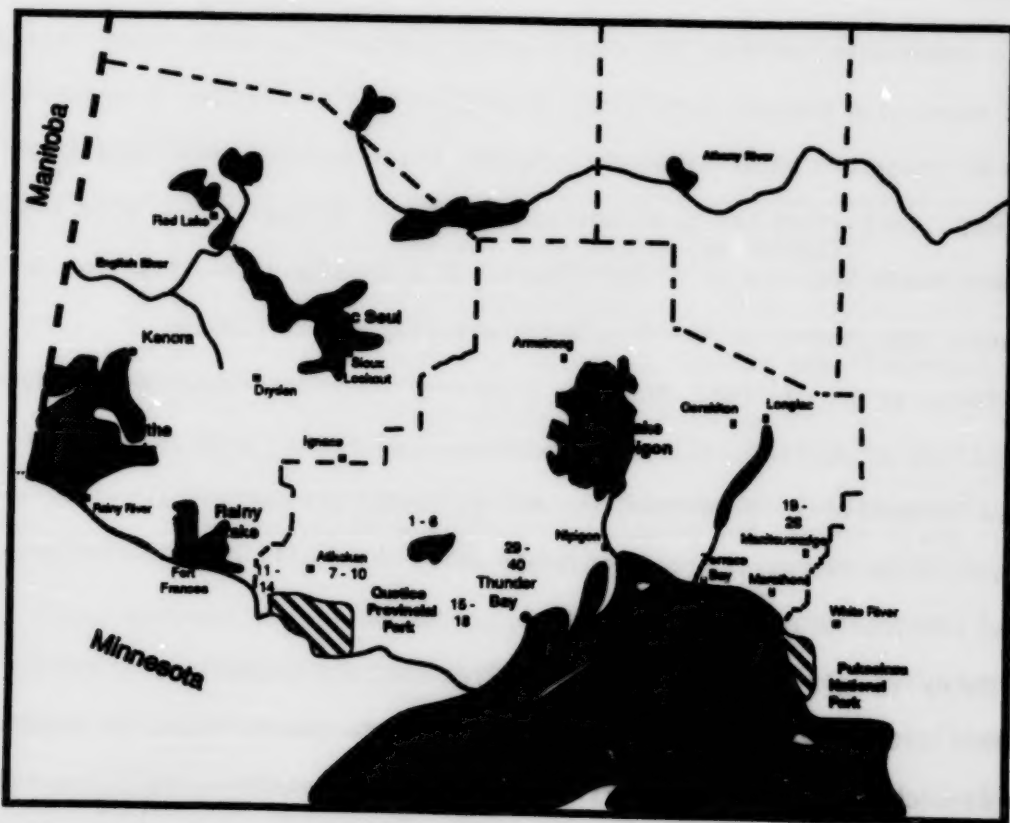


Figure 1. Study area with approximate locations of sample sites (numbers).

Data for this study were gathered from cutovers resulting from harvesting typical forest stands of northwestern Ontario. These stands encompassed a range of site and species compositions, but sampling was concentrated in commercially important lowland and upland forests.

Forest Ecosystem Classification

Forest ecosystems are forest/landscape units which resource managers consider when creating and implementing resource management strategies. Classification of forest ecosystems can provide for effective organization and communication of forest resource management knowledge and experience (Sims et al. 1989).

A stand-level system for classifying, identifying, and naming distinct forest vegetation and soil conditions in northwestern Ontario has been developed in the Northwestern Ontario Forest Ecosystem Classification (NWO FEC) (Sims et al. 1989). Each stand can be allocated into one of 38 Vegetation Types and the soil underneath into one of 22 Soil Types. At a broader level, i.e. for groups of stands, the concept of the Treatment Unit (TU) was developed.

Racey et al. (1989a) describe Treatment Units as "management-oriented aggregations of defined soil and vegetation conditions that possess similar species composition, productivity, macroclimate or ecological properties. Treatment Units represent broad landscape units which will respond similarly to a given silvicultural treatment regime".

Racey et al. (1989a) outline 11 Treatment Units defined primarily by overstory characteristics. Five of these include phases based on secondary features such as soil/site factors and understory vegetation conditions likely to influence responses to management practices. Preliminary interpretations of

these TUs for a variety of management considerations, including harvesting and site preparation, wildlife habitat, and competition potential have been developed (Racey *et al.* 1989a).

Sampling Sites

The NWO FEC Treatment Unit groupings were used to classify/define harvested sites surveyed in this study. Seven of the 11 Treatment Units defined by Racey *et al.* (1989a), were sampled (Appendix I). These seven TUs were prioritized for sampling such that the most commercially significant and commonly occurring were given priority (Table 1). Treatment Units F and G were grouped because of their similar overstory and associated soil conditions, and because the stands of these Treatment Units often receive similar silvicultural treatments.

Table 1. Prioritization of sampled treatment units.

TU E	-	Black Spruce - Jack Pine / Feathermoss
TU F	-	Jack Pine / Feathermoss
TU G	-	Jack Pine / Shrub Rich
TU B	-	Aspen Hardwood and Mixedwood*
TU D	-	Balsam Fir - White Spruce Conifer and Mixedwood*
TU J	-	Black Spruce / Wet Organic
TU C	-	White Birch Hardwood and Mixedwood*

* "Mixedwood" here is defined for the NWO FEC as stands comprised of a mixture of hardwood and conifer trees

Forty cutovers were selected for sampling across a broad range of stand and soil/site conditions typical of the North Central Region. Cutovers were selected from existing cutover maps in Thunder Bay, Atikokan and Manitouwadge. Since pre-cut stand information was not usually available, selected stands were assigned to a NWO FEC Treatment Unit from the Forest Resources Inventory (FRI)

stand label. These assignments were field-confirmed whenever possible in adjacent, residual stands.

All selected sites had been clearcut one to five years prior to sampling. Most cutovers had been mechanically site prepared but none had been chemically treated. Variation due to different site preparation techniques was not investigated in this study. Artificial regeneration had been implemented on approximately 30% of the sampled cutovers. Tree planting was the most common artificial regeneration method, although a few areas had been aerially seeded.

The majority of cutovers were on upland, mineral soils that were predominantly deep to moderately deep tills. Textures ranged from pure sand to coarse and fine loamy soils to clayey soils. Moisture regimes tended to be dry to fresh, and rapidly to well drained. In the lowlands, deep peat organic soils were encountered. Most were derived from *Sphagnum* spp. mosses and exhibited fibric and mesic decomposition levels. These organic soils were typically wet and poorly drained. Soil characteristics for each cutover are summarized in Appendix II.

Sampling Procedure

The sampling intensity for each Treatment Unit surveyed in this study is summarized in Table 2. On each cutover, a series of 2 m x 2 m temporary plots were established along transects across each cutover. Transects were oriented perpendicular to the direction of site preparation. Depending on cutover size, distance between plots ranged from 10 to 25 m and were predetermined to achieve unbiased coverage of site conditions. Samples were established on only one landform type across the transects.

Table 2. Number and age (years) of cutovers, and number of plots sampled for each Treatment Unit.

Treatment Unit	Number of Cutovers Sampled	Cutover Age (yrs.)	Total Number of Plots
B	8	2-5	40
C	3	2	15
D	7	1-4	32
E	8	1-4	36
F/G	7	1-3	33
J	<u>7</u>	2-4	<u>26</u>
TOTAL	40		182

Soil and vegetation assessments were performed on each 2 m x 2 m plot. At the centre of each plot, the FEC soil type was determined from augered soil samples. Soil moisture regime, drainage, calcareousness, and surface stoniness were also recorded. Percent cover of each shrub and herb species on the plot was recorded in five, 0.5 m height classes; 1) 0-0.49 m, 2) 0.5-0.99 m, 3) 1.0-1.49 m, 4) 1.5-1.99 m and 5) >2 m. Absolute heights of all regenerating conifers on the plot were also recorded. Species of grass and sedge were not distinguished in this study.

In addition to plot data, the silvicultural history of each sampled cutover was traced and recorded. Information regarding the year and method of harvest, site preparation, and artificial regeneration was recorded for each cutover.

Data Analysis

Vegetation communities sampled on harvested sites in this study were described using species frequency, percent cover, and height data. Height and cover data were also used to calculate a vegetation index (VI) for each competing

species. The method of calculating the vegetation index was adapted from a methodology being developed and tested by the Northwestern Ontario Forest Technology Development Unit (NWOFTDU) in Thunder Bay (Towill and Archibald 1991). The VI was calculated for each species by multiplying the estimated percent cover by the mean height within a height class. Vegetation Index values, combined with the frequency, cover and height data provided the basis for comparisons of post-harvest vegetation communities among Treatment Units.

It became apparent that post-harvest vegetation groupings could be effectively illustrated through ordination. Ordination is a computer-aided, mathematical procedure that provides a graphic representation of major trends in multivariate datasets (Hill 1979). Each sampling location is represented on an ordination diagram by a single point. The distance between any two points on the diagram illustrates the relative similarities between the two sampling locations. Points that are close together have similar characteristics; dispersed points indicate a lack of similarity in characteristics being sampled.

Ordination was employed in this study to illustrate the relative similarities in post-harvest vegetation communities among sampled cutovers and to investigate the association between pre-harvest classification units and post-harvest vegetation communities. The plant species and associated percent cover values from all 2 m x 2 m sample plots were ordinated using DECORANA (Hill 1979). Mean axes scores were computed for each cutover and used to produce an ordination diagram with forty points, each point representing a sampled cutover. This summary ordination diagram was used to compare post-harvest vegetation communities among Treatment Units defined by pre-harvest stand conditions.

RESULTS

Species Composition / Frequency of Occurrence

The combination of shrubs, herbs and grasses on each site varied between individual sites but the samples for each Treatment Unit grouping tended to have similar species combinations. Tables 3a and 3b summarize the frequency of occurrence data for all recorded shrubs and herbs by Treatment Unit. Overall, herbs tended to have less frequent occurrences than the shrubs - many herbs had only single occurrences in a Treatment Unit sample.

Twelve species were present in the samples of all six sampled Treatment Units: *Populus tremuloides*, *Betula papyrifera*, *Rubus idaeus*, *Vaccinium* spp., *Rosa acicularis*, *Amelanchier* spp., *Aster macrophyllus*, *Fragaria* spp., *Cornus canadensis*, *Epilobium angustifolium*, grasses, and sedges. Variation in occurrences of all other species ensured that each Treatment Unit grouping tended to have distinct species combinations.

Species such as *Populus tremuloides*, *Acer spicatum*, *Corylus cornuta*, *Diervilla lonicera*, *Rubus idaeus*, *Aster macrophyllus*, *Fragaria* spp., and grasses had the most frequent occurrences in TUs B and C, the hardwood-dominated mixedwood TUs. Numerous other shrubs and herbs occurred in TUs B and C but less frequently.

Treatment Unit D (balsam fir - white spruce conifer and mixedwood) also had frequent occurrences of *Acer spicatum*, *Corylus cornuta*, *Rubus idaeus*, *Aster macrophyllus*, *Fragaria* spp. and grasses but these species were not as predominant in this Treatment Unit as in TU B or TU C. Overall, the TU D sample had a wide variety of species each of which occurred with fairly equal frequency.

Table 3a. Percent frequency of occurrence of shrubs by each Treatment Unit (TU) in one to five-year-old cutovers in northwestern Ontario.

	Treatment Unit					
	B	C	D	E	F/G	J
	-----%					
<i>Abies balsamea</i>			6			15
<i>Acer rubrum</i>	15				9	
<i>Acer spicatum</i>	35	60	66		3	
<i>Alnus crispa</i>	10	7	6	11	21	
<i>Alnus rugosa</i>			6	14	3	31
<i>Amelanchier</i> spp.	8	13	16	11	9	4
<i>Betula papyrifera</i>	15	13	25	8	9	12
<i>Chamaedaphne calyculata</i>						42
<i>Cornus stolonifera</i>	3	7	3			
<i>Corylus cornuta</i>	60	47	31		9	
<i>Diervilla lonicera</i>	60	7	22	3	48	
<i>Gaultheria hispidula</i>				3		15
<i>Kalmia polifolia</i>				3		4
<i>Ledum groenlandicum</i>	3	7		58	9	88
<i>Lonicera canadensis</i>	3		3			
<i>Populus tremuloides</i>	83	40	28	6	64	27
<i>Prunus</i> spp.	10	20	9	6	15	
<i>Quercus</i> spp.	3					
<i>Ribes</i> spp.	10	13	13	3		4
<i>Rosa acicularis</i>	18	20	13	31	6	19
<i>Rubus idaeus</i>	38	93	78	53	42	35
<i>Salix</i> spp.	18		3	25	18	31
<i>Sorbus</i> spp.		7	16		6	
<i>Vaccinium</i> spp.	18	20	16	92	67	46
<i>Viburnum</i> spp.			3			
Total Number of Plots	40	15	32	36	33	26

Table 3b. Percent frequency of occurrence of herbs by Treatment Unit in one to five-year-old cutovers in northwestern Ontario.

	Treatment Unit					
	B	C	D	E	F/G	J
	-----%					
<i>Actaea rubra</i>	3				6	
<i>Apocynum androsaemifolium</i>					9	
<i>Aquilegia canadensis</i>			22	3	3	
<i>Aralia hispida</i>				14		
<i>Aralia nudicaulis</i>	10	7	16	6	9	
<i>Aster macrophyllus</i>	78	33	28	19	33	27
<i>Clintonia borealis</i>	8	13	19		3	
<i>Comptonia peregrina</i>	3				15	
<i>Cornus canadensis</i>	13	27	19	33	33	23
<i>Epilobium angustifolium</i>	18	27	25	22	15	50
<i>Equisetum</i> spp.	3			3		38
<i>Fern</i> spp.	18		9		12	
<i>Fragaria</i> spp.	25	40	41	22	9	31
<i>Galium</i> spp.	3		9			
<i>Linnaea borealis</i>			6		15	
<i>Lycopodium annotinum</i>		7	13			
<i>Lycopodium obscurum</i>	3		3			
<i>Lycopodium</i> spp.		7	6			
<i>Petasites palmatus</i>	3	7	13			
<i>Plantanthera</i> spp.	8					
<i>Polygonum convolvulus</i>	10	53	25		39	
<i>Solidago</i> spp.				6	6	8
<i>Streptopus roseus</i>	3			3		
<i>Taraxacum officinale</i>						
<i>Trientalis borealis</i>			3			
<i>Viola</i> spp.	3		6			
Other herbs	10	7	16	17		
<i>Carex</i> spp.	5	7	13	6	6	34
Grass spp.	45	87	38	58	42	62
<i>Cladina</i> spp.				3		
Total Number of Plots	40	15	32	36	33	26

On the jack pine-dominated sites of TU F/G, frequent occurrences of *Populus tremuloides*, *Diervilla lonicera*, *Rubus idaeus*, *Aster macrophyllus* and grasses were recorded. Also commonly found were *Vaccinium* spp., *Cornus canadensis*, and *Polygonum convolvulus*. Although there were many species in common, TU F/G tended to have less species diversity compared to TU's B, C, and D.

On the upland black spruce sites of TU E, only a limited number of shrubs and herbs were frequently recorded. The most common species were *Vaccinium* spp., *Ledum groenlandicum*, *Rosa acicularis*, *Rubus idaeus*, *Cornus canadensis* and grasses. These species combinations on TU E sites were quite different from those of TUs B, C, D, and F/G.

Lowland black spruce sites of TU J also had fewer and different shrubs and herbs compared to upland mixedwood sites of TUs B, C and D. Frequently occurring species in TU J included *Vaccinium* spp., *Ledum groenlandicum*, *Rubus idaeus*, *Salix* spp., *Alnus rugosa*, *Chamaedaphne calyculata*, *Fragaria* spp., *Epilobium angustifolium*, *Equisetum* spp., and grasses/sedges. Predominance of ericaceous shrubs (eg. *Vaccinium* spp., *Ledum groenlandicum*, *Chamaedaphne calyculata*) in TUs E and J was a significant change from the broad-leaved, deciduous species common to TUs B, C, D, and F/G.

Species Abundance and Height Development

Tables 4a and 4b show the mean percent cover by height class and Treatment Unit for all recorded species. Percent cover ranged from a mere presence (1%) by genera such as *Solidago*, *Lonicera*, and *Kalmia* to 75% by *Diervilla lonicera* on a single 2 m x 2 m plot. Vegetation height development ranged from ground level to well over 2 m.

Table 4a.

Mean percent cover of shrubs by height class and Treatment Unit (TU), in one to five-year-old cutovers in northwestern Ontario.

	TU B					TU C					TU D					TU E					TU F/G					TU J				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
	-----X-----																													
Abies balsamea	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	7	-	2
Acer rubrum	1	13	25	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	18	-	-	-	-	-	-	-	-
Acer spicatum	-	8	22	17	-	-	12	20	13	-	9	11	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Alnus crispa	-	-	-	7	-	-	2	-	-	-	5	-	1	-	-	-	13	3	10	-	-	10	28	-	-	-	-	-	-	-
Alnus rugosa	-	-	-	-	-	-	-	-	-	-	-	23	-	-	-	-	7	2	-	-	-	2	-	-	1	2	10	-	50	
Amelanchier spp.	-	4	-	-	-	-	2	-	5	-	2	1	9	-	-	1	1	3	-	-	2	2	-	-	1	-	-	-	-	
Betula papyrifera	-	7	2	5	3	-	3	-	-	-	1	9	5	-	-	1	-	-	-	-	-	5	-	6	2	-	-	-	-	-
Chamaedaphne calyculata	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7	29	-	-	-	
Cornus stolonifera	-	8	-	-	-	-	5	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Corylus cornuta	-	16	34	75	-	-	8	15	-	-	13	-	-	-	-	-	-	-	-	-	6	6	-	-	-	-	-	-	-	
Diervilla lonicera	10	20	-	-	-	-	75	-	-	-	12	5	-	-	-	-	2	-	-	-	11	19	-	-	-	-	-	-	-	
Gaultheria hispida	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-	-	-	-	16	-	-	-	-	
Kalmia polifolia	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1	-	-	-	-	
Ledum groenlandicum	-	1	-	-	-	-	10	-	-	-	-	-	-	-	-	5	7	45	-	-	26	-	-	-	16	29	-	-	-	
Lonicera canadensis	-	1	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Populus tremuloides	-	8	9	7	19	-	-	-	14	20	3	2	17	30	-	1	10	-	-	-	1	7	8	6	27	1	1	2	6	
Prunus spp.	-	-	1	3	7	-	3	1	-	-	-	2	10	5	-	2	-	-	-	-	3	-	8	30	-	-	-	-	-	
Quercus spp.	-	-	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Ribes spp.	2	5	-	-	-	4	15	-	-	-	4	3	-	-	-	4	-	-	-	-	-	-	-	-	-	1	-	-	-	
Rosa acicularis	-	6	-	-	-	-	2	-	-	-	4	5	-	-	-	2	9	2	-	-	2	-	-	-	-	4	35	-	-	
Rubus idaeus	5	24	12	-	-	1	8	36	-	-	9	15	58	-	-	2	14	-	-	-	5	10	-	-	2	15	-	-	-	
Salix spp.	-	2	2	13	-	-	-	-	-	-	-	20	-	-	-	-	9	3	-	-	8	2	6	-	1	2	5	-	-	
Sorbus spp.	-	-	-	-	-	-	1	-	-	-	2	2	5	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	
Vaccinium spp.	12	-	-	-	-	2	-	-	-	-	6	-	-	-	-	12	-	-	-	-	19	-	-	-	5	-	-	-	-	
Viburnum spp.	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	

Height Classes: 1) 0 - 0.49m 2) 0.5 - 0.99m 3) 1.0 - 1.49 m 4) 1.5 - 1.99m 5) > 2m

'75' - underline indicates percent cover for a species occurring on only one plot

Aster macrophyllus, *Fragaria* spp., and the grasses/sedges were typically the most abundant herbaceous species across all sampled Treatment Units. The mean percent cover by all other herbs varied among the Treatment Units. For example, ferns, *Clintonia borealis* and other herb species were typically most abundant on TU B sites, while ferns, *Polygonum convolvulus* and *Actaea rubra* were abundant on TU F/G.

Table 4b. Mean percent cover of herbs, grasses and sedges by height classes and Treatment Unit (TU) in one to five-year-old cutovers in northwestern Ontario.

	TU B					TU C					TU D					TU E					TU F/G					TU J				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
	-----X-----																													
Actaea rubra	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	<u>28</u>	-	-	-	-	-	-	-	-
Apocynum androsaemifolium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-	-	-	-	-
Aquilegia canadensis	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	1	-	-	-	-	1	-	-	-	-	-	-	-	-	-
Aralia hispida	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	<u>18</u>	-	-	-	-	-	-	-	-	-	-	-	-	-
Aralia nudicaulis	2	8	-	-	-	1	-	-	-	-	1	1	-	-	-	3	-	-	-	-	3	-	-	-	-	-	-	-	-	-
Aster macrophyllus	24	41	-	-	-	24	10	-	-	-	10	2	-	-	-	9	-	-	-	-	16	-	-	-	-	3	3	-	-	-
Clintonia borealis	24	-	-	-	-	5	-	-	-	-	4	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-
Comptonia peregrina	-	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	6	-	-	-	-	-	-	-	-
Cornus canadensis	4	-	-	-	-	10	-	-	-	-	5	-	-	-	-	4	-	-	-	-	11	-	-	-	-	4	-	-	-	-
Epilobium angustifolium	-	4	4	-	-	1	3	-	-	-	3	3	-	-	-	2	2	-	-	-	15	3	-	-	-	1	5	-	-	-
Equisetum spp.	<u>20</u>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-	5	-	-	-	-
Fern spp.	-	29	-	-	-	-	-	-	-	-	2	5	-	-	-	-	-	-	-	-	1	25	-	-	-	-	-	-	-	-
Fragaria spp.	14	-	-	-	-	18	-	-	-	-	13	-	-	-	-	13	-	-	-	-	9	-	-	-	-	24	-	-	-	-
Galium spp.	-	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Linnaea borealis	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
Lycopodium annotinum	-	-	-	-	-	1	-	-	-	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lycopodium obscurum	1	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lycopodium spp.	-	-	-	-	-	10	-	-	-	-	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Petasites palmatus	-	-	-	-	-	6	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Plantanthera spp.	3	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Polygonum convolvulus	11	-	-	-	-	7	-	-	-	-	4	-	-	-	-	-	-	-	-	-	14	-	-	-	-	-	-	-	-	-
Solidago spp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	-	-	-	-	-	1	-	-	-
Streptopus roseus	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Taraxacum officinale	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trientalis borealis	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Viola spp.	2	-	-	-	-	-	-	-	-	-	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other herbs	23	-	-	-	-	<u>10</u>	-	-	-	-	11	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Carex spp.	-	4	-	-	-	<u>50</u>	-	-	-	-	8	1	-	-	-	5	1	-	-	-	7	-	-	-	-	29	7	4	-	-
Grass spp.	5	28	5	-	-	10	10	-	-	-	7	21	-	-	-	12	2	-	-	-	7	13	-	-	-	19	9	-	-	-
Cladina spp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Height Classes: 1) 0 - 0.49m 2) 0.5 - 0.99m 3) 1.0 - 1.49 m 4) 1.5 - 1.99m 5) > 2m

'10' - underline indicates mean percent cover for a species occurring on only one plot.

Similarly, shrubs such as *Rubus idaeus*, *Ledum groenlandicum*, and *Populus tremuloides* were relatively abundant on all Treatment Units. Percent cover by species such as *Acer spicatum* and *Corylus cornuta*, however, was greater on sites of TU B, C, and D than on other TU's. *Vaccinium* spp. occurred on all Treatment Units but was most abundant in TUs E and F/G. Significant cover by *Chamaedaphne*

calyculata was restricted to TU J. Table 5 summarizes the most abundant herb and shrub species for each Treatment Unit.

Table 5. Summary of species with predominant mean cover values by Treatment Unit, sampled one to five years after clearcutting in northwestern Ontario.

Treatment Unit	Trees/Shrubs	Herbs/Grasses/Sedges
B	Corylus cornuta Rubus idaeus Diervilla lonicera Acer spicatum Acer rubrum Populus tremuloides	Aster macrophyllus Fragaria spp. fern spp. grasses
C	Populus tremuloides Acer spicatum Corylus cornuta Rubus idaeus Diervilla lonicera	Aster macrophyllus Cornus canadensis Fragaria spp. Lycopodium spp. grasses
D	Acer spicatum Corylus cornuta Rubus idaeus Salix spp.	Aster macrophyllus Fragaria spp. Lycopodium spp. grasses
E	Vaccinium spp. Ledum groenlandicum Alnus crispa	Aster macrophyllus Fragaria spp. grasses
F/G	Acer rubrum Diervilla lonicera Populus tremuloides Vaccinium spp. Ledum groenlandicum Alnus crispa Prunus spp.	Aster macrophyllus Cornus canadensis Polygonum convolvulus Actaea rubra
J	Ledum groenlandicum Alnus rugosa Rosa acicularis Chamaedaphne calyculata Gaultheria hispidula	Fragaria spp. grasses sedges

As expected, herbs occurred primarily in the first two height classes (up to 1 m) but were predominantly less than 0.5 m. Shrub species more typically grew in all five height classes. Only *Populus tremuloides*, *Betula papyrifera*, *Prunus* spp., *Alnus crispa*, *Alnus rugosa*, and *Abies balsamea* exceeded heights of 2 m. In general, the majority of post-harvest vegetation on all Treatment Units was less than 1 m in height.

Vegetation Indices

Species abundance and height data were used to calculate vegetation indices for each recorded species. Tables 6a and 6b list, by Treatment Unit, the mean vegetation index (VI) for each recorded shrub and herb species, respectively.

The upland, hardwood mixedwood types have the greatest number of species with high vegetation index values. Prolific development of many species on these sites is expected because of the richer conditions typically associated with them. In contrast, the conifer-dominated mixedwood types have no species with comparably high vegetation indices.

Species such as *Acer spicatum*, *Populus tremuloides*, *Corylus cornuta*, *Rubus idaeus*, *Aster macrophyllus*, and some ferns had much higher index values on TUs B and C than on TUs D, E, F/G, or J. Index values for shrub species were very similar between TU B and TU C. TU B tended to have several more herb species (and therefore herb VI's) than did TU C.

Table 6a. Mean Vegetation Index (VI) values by Treatment Unit for shrubs growing in one to five-year-old cutovers in northwestern Ontario.

	Treatment Unit					
	B	C	D	E	F/G	J
<i>Abies balsamea</i>	-	-	2.8	-	-	6.1
<i>Acer rubrum</i>	5.4	-	-	-	13.2	-
<i>Acer spicatum</i>	22.5	14.9	9.1	-	1.5	-
<i>Alnus crispa</i>	13.6	1.4	3.0	7.9	42.9	-
<i>Alnus rugosa</i>	-	-	29.2	1.8	3.4	25.9
<i>Amelanchier</i> spp.	3.2	4.9	3.8	1.7	0.8	0.3
<i>Betula papyrifera</i>	5.3	2.1	4.8	0.3	10.8	0.6
<i>Chamaedaphne calyculata</i>	-	-	-	-	-	6.2
<i>Cornus stolonifera</i>	5.6	3.5	0.3	-	-	-
<i>Corylus cornuta</i>	34.7	11.9	6.7	-	7.8	-
<i>Diervilla lonicera</i>	11.8	52.5	3.6	1.4	7.2	-
<i>Gaultheria hispidula</i>	-	-	-	0.5	-	1.2
<i>Kalmia polifolia</i>	-	-	-	-	-	0.3
<i>Ledum groenlandicum</i>	0.7	7.0	-	7.8	6.1	9.5
<i>Lonicera canadensis</i>	0.7	-	0.7	-	-	-
<i>Populus tremuloides</i>	24.0	29.3	13.2	6.6	12.4	4.4
<i>Prunus</i> spp.	7.3	2.7	10.8	1.0	10.9	-
<i>Quercus</i> spp.	8.5	-	-	-	-	-
<i>Ribes</i> spp.	0.8	5.0	1.4	1.2	-	-
<i>Rosa acicularis</i>	3.3	1.4	3.5	2.0	1.0	7.8
<i>Rubus idaeus</i>	15.1	10.8	9.3	4.1	2.0	3.9
<i>Salix</i> spp.	10.6	-	26.0	5.6	2.4	2.1
<i>Sorbus</i> spp.	-	0.7	3.5	-	5.1	-
<i>Vaccinium</i> spp.	2.7	0.3	1.6	4.7	5.5	1.2
<i>Viburnum</i> spp.	-	-	1.4	-	-	-

Treatment Unit D had an extensive species list with only a few shrubs and herbs having high index values. Highest values were for *Populus tremuloides*, *Salix* spp., *Alnus rugosa*, and *Prunus* spp. Because abundances tended to be relatively equal for all species in TU D, the high index values for these shrub species must reflect their mean heights. With the possible exception of grasses, *Fragaria* spp., and *Aster macrophyllus*, all herbs recorded on sites of TU D tended to have relatively low index values.

Table 6b. Mean Vegetation Index (VI) values by Treatment Unit for herbs growing in one to five-year-old cutovers in northwestern Ontario.

	Treatment Unit					
	B	C	D	E	F/G	J
<i>Actaea rubra</i>	1.4	-	-	-	7.5	-
<i>Apocynum androsaefolium</i>	-	-	-	-	1.6	-
<i>Aquilegia canadensis</i>	-	-	0.9	0.3	0.3	-
<i>Aralia hispida</i>	-	-	-	2.8	-	-
<i>Aralia nudicaulis</i>	2.2	0.3	0.3	0.7	0.7	-
<i>Aster macrophyllus</i>	8.9	6.7	2.5	2.9	3.6	1.5
<i>Clintonia borealis</i>	3.6	1.0	0.5	-	0.6	-
<i>Comptonia peregrina</i>	4.2	-	-	-	1.9	-
<i>Cornus canadensis</i>	1.3	0.9	0.3	0.8	2.6	0.5
<i>Epilobium angustifolium</i>	3.0	0.7	1.2	0.8	3.1	2.8
<i>Equisetum</i> spp.	6.0	-	-	1.2	-	1.3
<i>Fern</i> spp.	19.2	-	1.5	-	8.9	-
<i>Fragaria</i> spp.	1.2	1.5	2.4	1.4	1.0	2.4
<i>Galium</i> spp.	5.6	-	1.5	-	-	-
<i>Linnaea borealis</i>	-	-	0.3	-	0.1	-
<i>Lycopodium</i> spp.	0.3	1.5	1.3	-	-	-
<i>Petasites palmatus</i>	1.2	1.8	0.4	-	-	-
<i>Plantanthera</i> spp.	4.3	-	-	-	-	-
<i>Polygonum convolvulus</i>	3.4	0.7	0.9	-	3.2	-
<i>Solidago</i> spp.	-	-	-	0.7	0.3	0.7
<i>Streptopus roseus</i>	1.4	-	-	-	-	-
<i>Taraxacum officinale</i>	-	-	-	0.3	-	-
<i>Trientalis borealis</i>	-	-	0.1	-	-	-
<i>Viola</i> spp.	-	-	1.1	-	-	-
Other herbs	4.5	3.0	2.6	0.5	-	-
<i>Carex</i> spp.*	-	-	-	-	-	3.0
Grass spp.	9.0	5.7	4.7	3.4	3.0	6.8
<i>Cladina</i> spp.	-	-	-	1.0	-	-

* - Vegetation Index values for *Carex* spp. in TUs B, C, D, E, F/G were combined with those for grasses to obtain an overall mean index for grasses and sedges for these five Treatment Units

Some species of shrubs and herbs tended to have relatively high index values in TU F/G. The highest values were for *Alnus crispa*, *Acer rubrum*, *Populus tremuloides*, *Betula papyrifera*, *Prunus* spp., ferns and *Actaea rubra*. Although they occur on all Treatment Units, *Vaccinium* spp. have the highest VI on TU F/G.

Cornus canadensis and *Polygonum convolvulus* also have significant index values on TU F/G compared to other Treatment Units (Table 6b).

The limited number of different species in TUs E and J also tended to have lower overall vegetation index values. In TU E, *Ledum groenlandicum*, *Alnus crispa*, *Populus tremuloides*, *Salix* spp., *Aster macrophyllus* and grasses have the highest index values. However, when the same species occurred on other Treatment Units, their index values were typically higher (eg. *Populus tremuloides*, *Aster macrophyllus*). In TU J, high vegetation index values were calculated for *Alnus rugosa*, *Ledum groenlandicum*, *Rosa acicularis*, *Chamaedaphne calyculata*, grasses and sedges. Excluding *Alnus rugosa*, all index values for TU J were generally low (Tables 6a, b).

Pre- and Post-Harvest Vegetation Relationships

Figure 2 shows the summary graphic output resulting from the ordination of all vegetation data collected in this study. Each point on the diagram represents one of the forty sampled cutovers. Points that are close together have similar vegetation communities (species composition and abundance) and points that are separated have relatively dissimilar vegetation communities.

The majority of points in TU B are particularly tightly clustered but some are close to, and therefore similar to some of the sample points of TUs C, D, and F/G. Points within each of TU E, F/G, and J tend to be more dispersed but some of the sample points overlap slightly among these three TU groups. This distribution indicates a degree of variability within the TU sample as well as some similar conditions between these Treatment Units. Sample points for both TU C and TU D overlap. The small sample size for TU C is likely to have

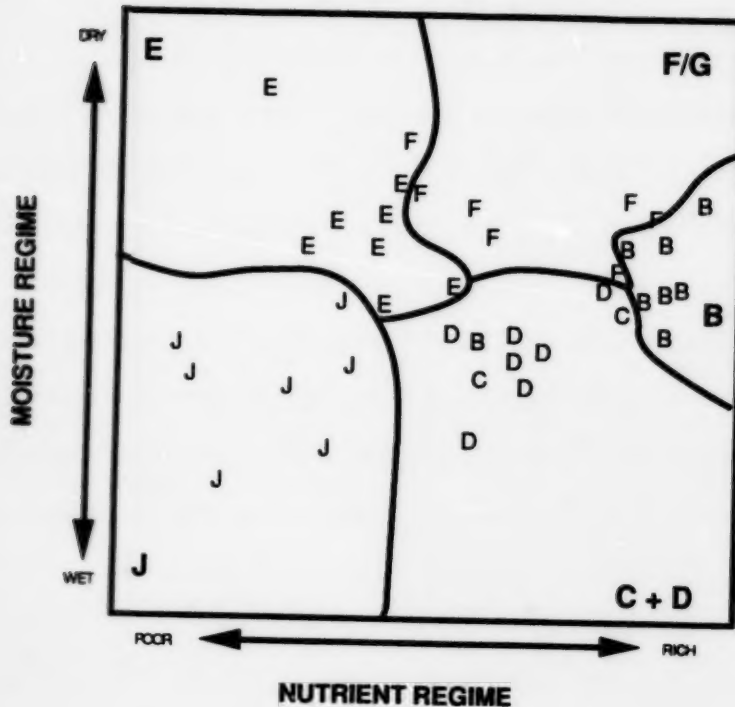


Figure 2. Ordination of cutover vegetation data. Letters correspond to Treatment Unit classification of the pre-harvest stand condition for each of the forty cutovers.

- B - Aspen hardwood and mixedwood
- C - White birch hardwood and mixedwood
- D - Balsam fir - white spruce conifer and mixedwood
- E - Black spruce - jack pine / feathermoss
- F - Jack pine / feathermoss // jack pine - shrub rich (G)
- J - Black spruce / wet organic.

influenced this distribution but it may also indicate that these TUs tend to share some post-harvest vegetation similarities. A couple of cutovers from Treatment Units C and D are in closest proximity to and are therefore most comparable to cutovers within TU B.

In contrast, the points for TU B are well separated from the points of TU J. Post-harvest vegetation conditions in these two Treatment Units are highly dissimilar. This should be expected since the site conditions associated with TU B and TU J are very different and therefore give rise to very different vegetation communities. Overall, the points within each Treatment Unit tend to form distinct groups on the ordination diagram.

DISCUSSION

Results from this preliminary study indicate that post-harvest vegetation development varies on different sites in terms of species composition, abundance and height development. A general gradient from diverse and abundant growth of herbs and shrubs to a relatively limited range of different species and height development, was described from TU B through to TU J respectively.

The range of vegetation conditions encountered across the Treatment Units undoubtedly reflects the range of associated site conditions. The hardwood dominated mixedwoods, TU's B and C, and the balsam fir - white spruce conifer and mixedwoods, TU D, are typically associated with fresh, coarse-fine loamy and clayey soils. These diverse site conditions give rise to rich and abundant plant growth.

Drier and coarser-textured soils characterize sites from TUs E and F/G. These TU's may also occur on very thin mineral soils overlying bedrock. In contrast, TU J sites typically occur on deep, wet, poorly drained organic soils. In all three of these Treatment Units, vegetation communities tended to contain few species with low nutrient requirements, clearly reflecting the limiting conditions of their soil/site environments.

Rates of height growth and abundance of species are two important factors in the consideration of competition potential. With height development, there is the threat of overtopping and shading of desired species, whereas if non-crop species are abundant, they can successfully compete for space, light, moisture and nutrients. As a result, non-crop vegetation having both good height development and high abundance will likely impose significant competition on desired species. Comparison of vegetation indices provided an effective means of simultaneously evaluating the height and abundance of a variety of species across the Treatment Units sampled.

The Vegetation Index, while useful for considering abundance and height of species, cannot be used explicitly for assessing competition potential. However, by studying the VI values, one can obtain a sense of the impact of each species on the site in terms of its potential for crowding and overtopping other plant individuals.

For each of the sampled Treatment Units, different groups of species had high VI's indicating their significant abundance and/or height development, and hence, the potential for significant impact on other species on the site. On sites of TU B and TU C, forest managers may be concerned about potential competition from *Acer spicatum*, *Corylus cornuta*, *Populus tremuloides*, *Diervilla lonicera*, *Rubus idaeus*, *Aster macrophyllus*, and grasses. On TU D, species of concern might include *Populus tremuloides*, *Acer spicatum*, *Rubus idaeus*, *Aster macrophyllus*, *Fragaria* spp., and grasses.

Treatment Units E, F/G and J tended to have lower mean vegetation index values, indicating smaller abundances and/or lower height development of species on these sites. Highest index values on TU E were for *Vaccinium* spp., *Ledum groenlandicum*, *Salix* spp., *Alnus crispa*, *Aster macrophyllus* and grasses. In TU

F/G, species such as *Populus tremuloides*, *Betula papyrifera*, *Corylus cornuta*, *Alnus crispa*, ferns, *Actaea rubra*, *Polygonum convolvulus* and grasses may pose a competition problem. *Alnus rugosa*, *Rosa acicularis*, *Ledum groenlandicum*, *Chamaedaphne calyculata*, grasses and sedges all had significant abundance and/or height on TU J and may therefore create a competition problem on those sites.

Comparison of species composition, abundance and heights on the sampled cutovers indicated patterns in post-harvest vegetation communities. These patterns were clearly demonstrated in the diagram resulting from the ordination process (Figure 2). Distinct clusters of points on the diagram represent the post-harvest vegetation communities. The ordination diagram indicates that the Treatment Unit groupings, which are based on mature stand conditions, can be effective in classifying post-harvest vegetation conditions. This implies that if a site is classified before harvesting to a NWO FEC Treatment Unit, it is possible to estimate post-harvest vegetation characteristics for that site.

Potential Implications for Forest Management

Results from this preliminary study indicate that a relationship exists between pre-harvest stand classification units and post-harvest vegetation communities. There is, therefore, considerable potential for developing a proactive forest management planning tool to allow a forest manager to predict post-harvest vegetation communities from pre-harvest stand data.

From a vegetation management perspective, the usefulness of such a predictive capability would require a more precise evaluation of the degree of potential competition imposed by each vegetation community. Additionally, it must be determined how silvicultural practices could exacerbate/ameliorate the competition problem. Forest managers would then have the capability to modify

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The Vegetation Index, while useful for considering abundance and height of species, cannot be used explicitly for assessing competition potential. However, by studying the VI values, one can obtain a sense of the impact of each species on the site in terms of its potential for crowding and overtopping other plant individuals.

For each of the sampled Treatment Units, different groups of species had high VI's indicating their significant abundance and/or height development, and hence, the potential for significant impact on other species on the site. On sites of TU B and TU C, forest managers may be concerned about potential competition from *Acer spicatum*, *Corylus cornuta*, *Populus tremuloides*, *Diervilla lonicera*, *Rubus idaeus*, *Aster macrophyllus*, and grasses. On TU D, species of concern might include *Populus tremuloides*, *Acer spicatum*, *Rubus idaeus*, *Aster macrophyllus*, *Fragaria* spp., and grasses.

Treatment Units E, F/G and J tended to have lower mean vegetation index values, indicating smaller abundances and/or lower height development of species on these sites. Highest index values on TU E were for *Vaccinium* spp., *Ledum groenlandicum*, *Salix* spp., *Alnus crispa*, *Aster macrophyllus* and grasses. In TU

F/G, species such as *Populus tremuloides*, *Betula papyrifera*, *Corylus cornuta*, *Alnus crispa*, ferns, *Actaea rubra*, *Polygonum convolvulus* and grasses may pose a competition problem. *Alnus rugosa*, *Rosa acicularis*, *Ledum groenlandicum*, *Chamaedaphne calyculata*, grasses and sedges all had significant abundance and/or height on TU J and may therefore create a competition problem on those sites.

Comparison of species composition, abundance and heights on the sampled cutovers indicated patterns in post-harvest vegetation communities. These patterns were clearly demonstrated in the diagram resulting from the ordination process (Figure 2). Distinct clusters of points on the diagram represent the post-harvest vegetation communities. The ordination diagram indicates that the Treatment Unit groupings, which are based on mature stand conditions, can be effective in classifying post-harvest vegetation conditions. This implies that if a site is classified before harvesting to a NWO FEC Treatment Unit, it is possible to estimate post-harvest vegetation characteristics for that site.

Potential Implications for Forest Management

Results from this preliminary study indicate that a relationship exists between pre-harvest stand classification units and post-harvest vegetation communities. There is, therefore, considerable potential for developing a proactive forest management planning tool to allow a forest manager to predict post-harvest vegetation communities from pre-harvest stand data.

From a vegetation management perspective, the usefulness of such a predictive capability would require a more precise evaluation of the degree of potential competition imposed by each vegetation community. Additionally, it must be determined how silvicultural practices could exacerbate/ameliorate the competition problem. Forest managers would then have the capability to modify

plans for timber harvest, site preparation, regeneration and tending in anticipation of potential vegetative competition.

The ability to predict post-harvest vegetation communities from pre-cut stand data might also be useful in efforts to ensure successful plantation establishment. Several authors (McMinn 1977; Scarratt 1982; Wood and Campbell 1988; Racey *et al.* 1989b) have suggested the need to give greater consideration to the conditions of the planting site when choosing planting stock.

The ability to predict post-harvest vegetation communities on a range of sites, as well as the degree of potential competition from each, is essential to the success of matching planting stock and planting site. By anticipating post-cut vegetation conditions, site-appropriate nursery stock type could be selected for each planting site early in the planning process. Nursery managers could also benefit from early stock selections to more efficiently plan their nursery programs.

Recommendations for Further Study

Results from this study indicate that post-harvest vegetation communities can be distinguished using pre-cut site classification units, and that development of a proactive tool for predicting vegetation development on different sites is feasible. This study, however, was preliminary in nature and somewhat limited in its scope. It is recommended that the following be considered for further investigation in this area:

1. Determine the species composition, and the level of vegetation abundance, cover, and height that constitutes significant competition with various combinations of crop/non-crop species.

2. Broaden the scope within northwestern Ontario:
 - a) obtain more samples from across the area encompassed by the NWO FEC system;
 - b) sample TU's F and G separately;
 - c) sample more site types defined by NWO FEC eg. TU H (red and/or white pine) and TU I (jack pine - black spruce/blueberry/lichen).
3. Broaden the scope across northern Ontario, to encompass all parts of the boreal forest:
 - a) sample in other Regions and evaluate the predictability of post-cut vegetation development using their particular site classification systems.
4. Investigate responses to various silvicultural treatments on different site types:
 - a) impacts of various harvesting methods on vegetation dynamics;
 - b) impacts of various site preparation methods on vegetation dynamics;
 - c) success of different site-specific nursery stock selections;
 - d) effectiveness of various vegetation management options.

SUMMARY AND CONCLUSIONS

This project was conducted to provide preliminary observations and descriptions of vegetation communities developing on a range of newly harvested sites in northwestern Ontario. The primary goal was to determine whether a relationship existed between pre-harvest stand classification units and post-harvest vegetation community development. In this study, NWO FEC Treatment Units were used to define the site types sampled and provide the basis for data comparisons.

Forty cutovers encompassing six Treatment Unit groups were sampled across the North Central Region. All cutovers were one to five years old, most had been mechanically site prepared, but none had been chemically treated. All sites had been revegetated, primarily by naturally occurring non-crop, competing species. Artificial regeneration of conifer species had been implemented on approximately

30% of the sampled cutovers, and this accounted for the majority of the occurrence of conifers on the sites.

Species composition, abundance and height development were described for each sample site. When considered within the context of Treatment Units, patterns emerged in the vegetation characteristics among different sites. The ordination process showed that each Treatment Unit tended to display distinct post-harvest vegetation communities as well as a strong relationship between the pre-harvest classification units and the post-harvest vegetation communities.

Preliminary descriptions of post-harvest vegetation communities on sites of different NWO FEC Treatment Units indicate significant potential for the development of a predictive tool for forest management planning. Such a tool could have applications in timber harvest and site preparation prescriptions, as well as in planning nursery stock selections. However, it is recommended that additional sampling be carried out to refine the site descriptions of post-harvest vegetation development and to further substantiate these preliminary findings. It is also suggested that competition potential be more clearly defined and that the effectiveness of various vegetation management options on different sites be investigated. Results from such studies would assist forest managers in making more effective silvicultural plans.

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APPENDIX I

Descriptions of NWO FEC Treatment Units

(from Racey et al., 1989a)

TU**B Aspen Hardwood and Mixedwood (V5,V6,V7,V8,V9,V10,V11,V19)***

- stands of pure aspen or aspen mixed with white birch, balsam fir, jack pine, black spruce or white spruce; understory productive with dense, tall and low shrub layer
- on dry to fresh, sandy/coarse loamy soils, or on moist, fine loamy and clayey soils

C White Birch Hardwood and Mixedwood (V4)

- white birch dominated stands with varying amounts of white spruce, balsam fir, black spruce, jack pine, or sometimes trembling aspen; ranges from shrub rich to relatively shrub poor
- usually on deep, dry to fresh, sandy/coarse loamy soils, with a high coarse fragment content

D Balsam Fir-White Spruce Conifer and Mixedwood (V14,V15,V16,V21,V24,V25)

- very diverse upland conifer and mixedwood stands with merchantable balsam fir and white spruce, and associated secondary species including white cedar, trembling aspen and black spruce; tend to be shrub rich
- very productive sites; on deep to moderately deep, dry to fresh, sandy/coarse loamy soils, or on deep, moist to very moist, loamy and clayey soils

E Black Spruce - Jack Pine / Feathermoss (V19,V20,V31,V32,V33)

- even-aged, black spruce and jack pine stands with a poor to moderately well-developed shrub layer; feathermoss cover often high
- occurs on a range of soil conditions including very shallow, sandy soils, deep mineral soils of various textural classes and moisture regimes, and deep organic soils

F Jack Pine / Feathermoss (V18,V29,V31,V32)

- even-aged stands of jack pine or jack pine with black spruce, with extensive feathermoss ground cover; aspen or birch may occur in limited amounts
- on deep, dry to fresh, sandy/coarse loamy soils

G Jack Pine / Shrub Rich (V11,V17,V28)

- jack pine with some trembling aspen and a generally rich, diverse, low shrub component
- on deep, dry to fresh, sandy/coarse loamy soils

J Black Spruce / Wet Organic (V22,V23,V34,V35,V36,V37)

- lowland black spruce in association with white cedar or tamarack
- ranging from rich in Alnus rugosa (Phase J1) to less-developed Alnus rugosa shrub layers (Phase J2)
- on deep, wet, organic and peaty phase soils

* V5, etc. are Vegetation Types, the stand-level unit for classifying the vegetation component of mature forest stands in the NWO FEC.

APPENDIX II

Summary of Soil Conditions Sampled
on Forty Cutovers in North Central Region



TU	Cutover No.	Dominant* Surface Texture	Dominant Subsurface Texture	Moisture Regime	Drainage
B	7	SimS	bedrock	fresh	well
B	12	SL	bedrock	-	-
B	13	LS	bedrock	-	-
B	15	SifS	bedrock	-	-
B	31	LfS	fS	fresh	v. rapid
B	32	LfS	bedrock	fresh	rapid
B	36	SL	bedrock	-	-
B	39	LmS	bedrock	dry	rapid
C	26	SifS	bedrock	fresh	well
C	27	-	vfS	fresh	well
C	35	SCL	bedrock	fresh	mod. well
D	8	SCL	C	fresh	well
D	18	SifS	bedrock	-	-
D	21	SifS	bedrock	fresh	well
D	29	LS	bedrock	dry	rapid
D	30	SifS	bedrock	v. fresh	well
D	33	SL	bedrock	fresh	well
D	34	SCL	bedrock	-	-
E	2	-	fS	fresh	rapid
E	3	-	fS	fresh	rapid
E	19	-	bedrock	-	-
E	20	-	SifS	moist	well
E	25	organic	bedrock	-	-
E	28	-	cS	dry	v. rapid
E	37	-	bedrock	-	-
E	40	SL	bedrock	-	-
F/G	1	LfS	mS	fresh	v. rapid
F/G	4	SifS	fS	fresh	rapid
F/G	6	LmS	mS	dry	rapid
F/G	10	SL	bedrock	-	-
F/G	11	SL	bedrock	-	-
F/G	14	-	bedrock	-	-
F/G	38	LmS	bedrock	dry	rapid
J	5	organic	organic	wet	v. poor
J	9	organic	fS	wet	v. poor
J	16	organic	organic	wet	v. poor
J	17	organic	organic	wet	v. poor
J	22	organic	SivfS	moist	imperfect
J	23	organic	SivfS	wet	v. poor
J	24	organic	Si	wet	v. poor

* Abbreviations: S = sand, Si = silt, C = clay, L = loam, f = fine, m = medium, c = coarse, v = very, mod = moderately.